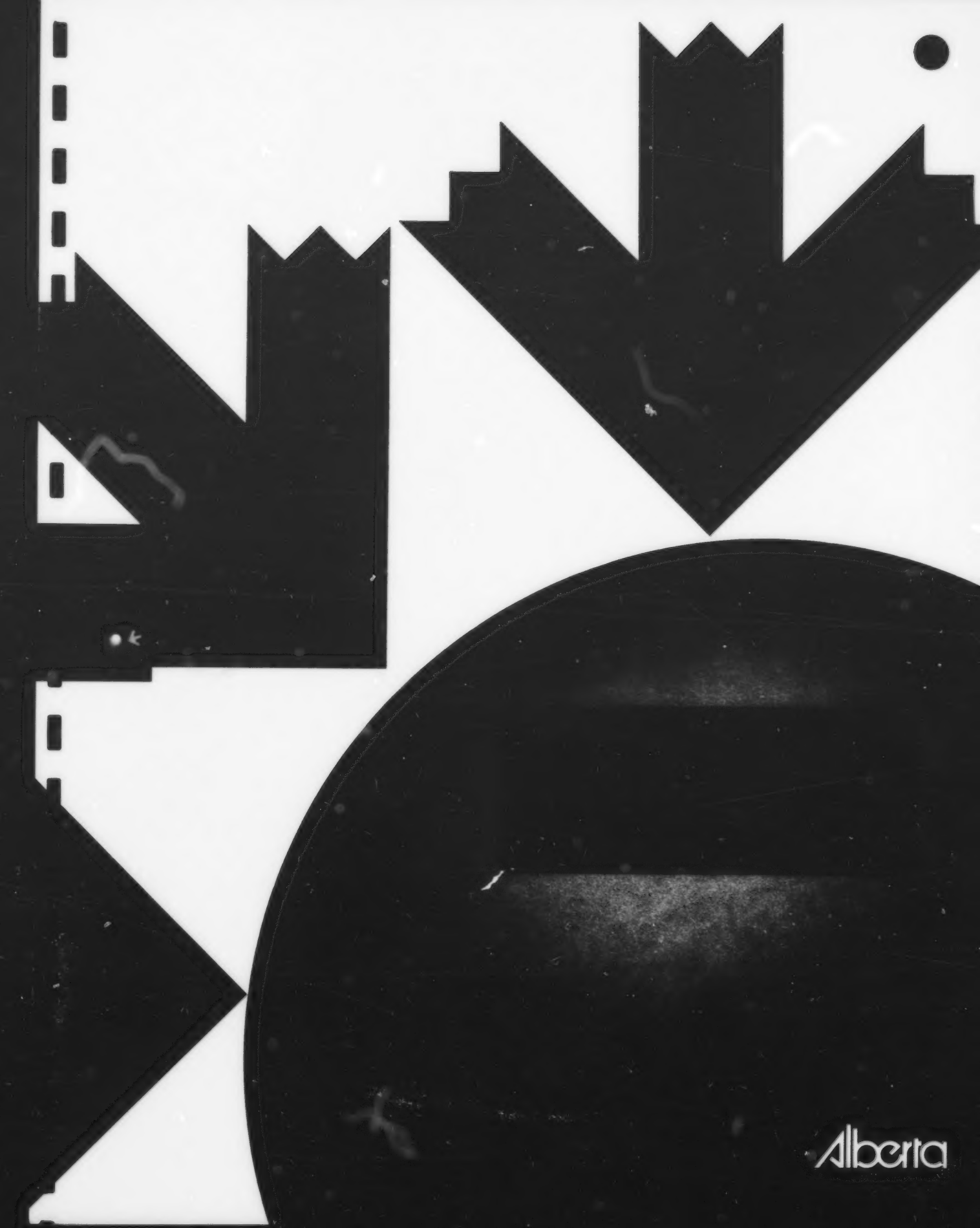
Alberta

RESPONSE TO TOWARD 2000 TOGETHER

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PREMIER'S COUNCIL ON SCIENCE AND TECHNOLOGY

RESPONSE TO

TOWARD 2000 TOGETHER

1. INTRODUCTION ..... p. 1

2. FISCAL CHALLENGES ..... p. 2

3. AVAILABILITY OF CAPITAL ..... p. 6

4. QUALITY MANAGEMENT ..... p. 9

5. CREATING THE KNOWLEDGEABLE CITIZENRY NECESSARY FOR A KNOWLEDGE-BASED FUTURE p.11

INTRODUCTION

In the view of the Premier's Council on Science and Technology, Alberta's economic competitiveness is steadily eroding. This erosion is caused by fundamental structural difficulties that must be remedied.

- *We tend to think and act in the short term while our international competitors tend to think and act in the long term.*

- *Our economy is permeated by some ineffective incentives, such as:*

  - *tax laws that penalize savings, do not encourage investment and favor consumption and debt;*
  - *a political process that rewards spending and tax cutting rather than prudent fiscal policies and maintenance of public infrastructure;*
  - *an education system that offers too few incentives to good student performance; and,*
  - *pressure from financial markets and high debt-equity ratios that favor management emphasis on short range strategies, and a structure of company management that needs to be re-examined.*

- *Lack of sufficient global thinking even though we are critically dependent on foreign markets. For example, Government subordinates global competitiveness to other objectives in determining budget, tax, social, education, environmental and other key policies.*

- *Alberta suffers from an excessive reliance on exploiting natural resources, without upgrading them, an approach which is doomed to failure in the medium- and long-term as basic commodities decline in value. We address this later on p. 6.*

These are issues where we will all, as individuals and as organizations, have to be part of the solution. The following discussion paper from the Council deals with four major subject areas. Recommendations are made on some specific matters that the Council has addressed in its deliberations.

FISCAL CHALLENGES

INTRODUCTION

The Premier's Council on Science and Technology has identified four potential actions to address the financial challenge of high government debt which is limiting our maneuverability in adapting to the 21st century. It is likely that each will have to be implemented to a greater or lesser extent.

These actions are:

- *Increase Alberta's tradeable goods and services, especially by adding value* to them;*
- *Make Government's operations more efficient, including making regulatory controls more effective and efficient;*
- *Reduce Government's expenditures; and,*
- *Increase Government's income.*

The Premier's Council sees the latter two points as temporary solutions. To achieve any fundamental and lasting improvement, the first two issues are of greatest importance.

INCREASED VALUE-ADDED TO ALBERTA'S PRODUCTS

This must be done by Alberta's private sector, with the active support of the Government and the public at large.

Traditionally Alberta's products have been in the agricultural, tourism and energy fields, and more recently in the forestry area. Unfortunately, there has been relatively little upgrading or processing of them. We must continue to push exports of these goods and services because these are areas of our expertise, and current source of income.

However, in the future we must actively concentrate on upgrading these products. Their quality and nature must be improved. We must also pay more attention to our customer's wants and needs, and continually strive to exceed their expectations. By increasing our sale of tradeable goods and services we will enlarge the "pie" from which Government may derive revenues.

The foregoing can be substantially assisted by the application of science, technology, design and quality management principles to the production of our natural resources and other existing tradeable goods and services.

*Added value is defined as the difference between the total value of output minus the value of purchased materials input.

Many Albertans will be able to continue what they are doing now. However, they must find ways of doing it better. This will likely be through the application of technology. The technologies involved will be largely in the areas of communications, information technology, biotechnology and advanced materials. Not only will the application of these technologies to our traditional industries improve productivity, competitiveness and the international saleability of our products, but they will also eventually spawn new industries in Alberta. Of course, these areas are being emphasized in many jurisdictions, and there will be intense competition. Nevertheless, we must make the exceptional efforts required if we are to maintain our current infrastructure and standard of living.

We already have a number of companies in Alberta which sell products and services abroad, and which exploit these new technologies. But we need many, many more of them. We also have a large number of highly trained engineers, scientists and technologists who are currently unemployed or underemployed. The challenge is to bring these needs and opportunities together by developing a business climate that encourages technology-intensive entrepreneurship.

To achieve the above objective will not be easy. It will require that Government create an environment that will encourage firms to produce goods and services that are wanted by customers outside the Province. It will take several years to be realized, and will require an outstanding effort by Alberta companies and their employees to be successful, as well as the full support of the Provincial Government and the public generally.

A major coordinated effort will have to be mounted by all parts of the community (where this has not already been done):

- *business/industry in particular will have to accept that research development and design are essential to the future of their organizations;*
- *they will have to become totally customer/client/user oriented and be especially prepared to do so for customers in global markets;*
- *they will have to adopt the latest management, marketing and manufacturing technologies and methods;*
- *they will have to be prepared to make the maximum use of their employee's abilities, and to "empower" them and train them, while the employees in their turn will have to accept greater responsibility and be prepared to undergo substantial training and upgrading;*
- *the public will have to become more aware of science and technology, its implication on their lives and its ability to create wealth and increased productivity and competitiveness;*
- *academic institutions will have to pay more attention to the needs of society and students, and to more effective ways of teaching and learning;*
- *the Government will have to create an environment which understands and accepts business risk and entrepreneurship, and supports it strongly through appropriate financial and other incentives, etc.*

The implementation of these suggestions will require a major cultural change on the part of many Albertans. They will require the reallocation of existing resources. Without these changes it seems likely that Alberta's standard of living will fall substantially in the coming years.

INCREASED EFFICIENCY IN GOVERNMENT AND SOCIETY OPERATIONS

The Provincial Government should introduce productivity measurements into its operations. In this connection the Council suggests that the Government introduce the concept of quality management into its own operations and those of Government supported organizations such as academic institutions, municipalities and hospitals (see p. 9 for further discussion on quality management) where this has not already been done.

In the private sector it is clear that the introduction of quality management concepts reduces the costs of operations, improves the quality of the products and services provided, and increases customer/user satisfaction. There seems to be a reasonable potential that similar results can be achieved in public sector organizations as well, as is indicated by the experience of quality management in some of Alberta's major hospitals.

The implementation of quality management requires a cultural change in institutions. It is not a quick fix, but rather, is a long term one (i.e., five years or more for full implementation) requiring significant changes in management style.

The Government has already initiated a program to voluntarily introduce quality management concepts into those areas where the bureaucracy is willing to take the initiative. This development would be substantially speeded up if Cabinet were to vigorously support it.

Government must also re-examine the need for the multiplicity of permits, licenses, hearings and court challenges implicit in the current administration of its regulations. In particular, there are often conflicting demands upon companies by officials representing different departments of Government. And Alberta must ensure that it is not putting undue demands on our companies that are not required of them in other jurisdictions.

We must also re-examine what business the Government should be in. Should all the services now provided be continued or can some be done by the private sector? The rationalization of the activities and services of the three levels of government needs to be examined as well.

REDUCED EXPENDITURES BY GOVERNMENT

The Government must continue to look at ways to reduce its expenditures. To date it has mainly done this by reducing the costs related to personnel, supplies and services, capital costs and grants, and loans and guarantees to companies.

The Premier's Council is philosophically opposed to the Government purchasing equity and debt of companies and to providing loan guarantees. However, since the "playing field" for Alberta companies, relative to many other jurisdictions is not "level", the Government must do something. **Hence, it is recommended that company financial support be handled through an arm's length organization from Government, that any additional financing (through this proposed organization) be minor compared to the private sector, that in additional financing after the initial one the Government's overall share remain as it was initially, and that the industry sector in which the company operates be one which is important to the Government's industrial strategy.**

INCREASED INCOME

Science and technology can play a role in increasing the Government's income. There is technology which has been developed by the Government which has potential commercial value. There are also systems which have been developed by the Government in the normal course of its operations, which could potentially be sold to companies and jurisdictions outside Alberta, as a means of generating some income. **The Government should reallocate existing resources to create a small group to consider ways of selling and marketing public sector intellectual property.** Consideration should be given to the promotion of a private sector market-driven initiative for this purpose.

AVAILABILITY OF CAPITAL

SUMMARY

The Council is dissatisfied with the present level of growth of technology intensive firms in this Province. It is insufficient to provide the economic growth to allow Albertans to meet their expectations regarding their future economic and social well being. Such firms must be encouraged now. ACTION IS URGENT.

Given the current business climate, it is unlikely that firms will be able to meet this challenge adequately. This climate must be changed significantly if corporate growth rates are to increase substantially.

Three themes are dominant:

- *a strong strategic plan for science, technology and industry that announces specific priority areas for development, is required for the Province,*
- *more effective linkage between the science and technology activities of the Government, industry and universities is required, with each other, and related organizations elsewhere in the world; and,*
- *the business climate must be substantially altered so as to greatly increase Albertans' interest in and willingness to undertake technological innovation.*

INTRODUCTION

Traditionally, Alberta's wealth was derived from agricultural and energy resources. However, these sources of wealth are no longer adequate to meet our needs, because:

- *the income from these resources is steadily decreasing as international commodity prices decline;*
- *our energy resources are depleting rapidly; and,*
- *the international marketplace is now demanding substantially more sophisticated goods and services than in the past.*

While Alberta has more recently given considerable impetus to the forestry and tourism industries, these alternatives to our traditional goods and services must obviously be supplemented substantially.

Just as many other jurisdictions have done, Alberta have to rely to a greater extent on the intellectual resources of its citizens. We must add value to our traditional resources through further processing and application of new technologies. By creating enterprises that use new technologies - such as electronics, information technology, biotechnology, and advanced materials - we improve the quality of products from our traditional industry sectors, and develop new industry sectors.

The Premier's Council on Science and Technology believes that there is insufficient capital available in the current economic climate to develop and sustain a sufficient number of emerging technology companies to replace the income formerly generated by the agricultural and energy industries.

RECOMMENDATIONS

The Council supports the philosophy that the Government should not attempt "to pick winners". However, at the current levels of taxation by all three levels of government, the public sector has garnered unto itself those funds which would otherwise be used in our society as money to start new enterprises. Hence, Government must take some action to make more money available for technology intensive business initiatives.

It is recommended that the Government should look at a four-pronged approach to this problem:

1. One alternative that has been widely recommended across Canada concerns the capital gains tax. **Where investments are made in companies active in technology areas which are a priority to Government's and are kept for a few years (i.e., three to five), there should be no, or at least substantially reduced, capital gains tax.** Such a provision would be anticipated to make investments in technology intensive businesses much more attractive than is presently the situation. There is evidence from the U.S. experience that this option is effective in making more venture capital available.

   As well, **the Government should initiate a program to give some form of financial support to industrial research consortia.** These are organizations where member companies, institutions, and government bodies join together to support and/or undertake precompetitive applied research projects.

2. Although the Premier's Council on Science and Technology is philosophically opposed to direct Government intervention in company support, it believes that in the present economic climate, such support is necessary. But, the following guidelines, should be strictly adhered to:

   - *the Government should only become financially involved with companies through arms-length organizations, operating independently of Government;*
   - *existing Government-supported financial institutions, where this is not already the situation, should make available to themselves personnel with expertise in emerging technology enterprises;*
   - *the Government should be a minor financial supporter in those proposals it chooses to invest in and there should be, majority financial support from the private sector;*
   - *subsequent Government financing should be on the same pre-conditions, and proportion, as the initial financing; and,*
   - *Government investments should be restricted to industry sectors which are defined in the Province's industrial R&D strategy.*

3. **The Government must study the effect its present tax structure has on business decisions.** Taxation forms such a significant part of business activity that it is never a neutral factor as is sometimes alleged. It might be quite possible to restructure the tax system, to give the same revenue to Government, and at the same time encourage business/industry to make decisions which would better match overall public needs. It has been suggested, for example, that the present system encourages a company to choose to make operating expenditures rather than capital expenditures - to make short term business decisions rather than long term ones - to invest in real estate rather than equities and bonds (where taxes have to be paid annually on dividends and interest).

4. **The Premier's Council on Science and Technology recommends that the tax system should be used to a greater extent as an incentive device to encourage technology intensive companies. However, the Council does not have the technical expertise available to make specific recommendations. Consequently, it is suggested that the Government convene a distinguished panel to investigate this matter. In particular, the suggested panel should examine:**

   - *stock savings plans;*
   - *investment tax credits;*
   - *capital cost allowances;*
   - *incentives provided by other provinces, states and jurisdictions;*
   - *other tax or expenditure incentives.*

Finally, in the view of the Council, the Government should issue a clear unequivocal statement of its intention to improve the economic climate for emerging technology firms, as well as to work with other levels of government in doing so.

QUALITY MANAGEMENT

SUMMARY

All of Alberta's publicly supported institutions - the Provincial Government itself, municipal governments, education establishments, hospitals, etc. - must become more user/customer/client/patient oriented. They must strive for zero defects. One way of doing this is through adoption of quality management concepts.

INTRODUCTION

In order for Alberta to maintain its current high living standard as we enter the "knowledge age", we are going to have to make changes in the things we do and how we do them. One of the most important of these changes will be in the way in which organizations are managed.

The new management philosophy goes by several names, among which are Total Quality Management, Total Quality Improvement, and Strategic Quality Improvement. Whatever the name, the ideas behind the philosophy are the same. One is that all employees, especially those dealing with the organization's customers, clients, etc., are "empowered" to act with a minimum number of referrals to their supervisors. Also, organizations become much more customer and client directed, and strive to exceed customer's expectations and needs. As well, organizations strive for zero defects in their operations.

The Premier's Council on Science and Technology recommends that the Government itself, the institutions it supports, and especially Alberta companies, should adopt this management philosophy as soon as possible.

RECOMMENDATIONS

Firstly, the Council believes that the Government itself, in its own day-to-day operations, should adopt quality management concepts. While these concepts were developed for manufacturing enterprises, they can be adapted to public sector organizations. In fact, there are a number of examples in various Canadian jurisdictions where this has been done.

The advantages to Government will be, that after some initial increased expenditures resulting from implementation, overall costs of operations will decline, the public will be more satisfied with Government's services and performance and non-management employees will realize increased job satisfaction. However, the "management culture" in the bureaucracy will have to change substantially.

It is also important that those institutions, like hospitals, educational establishments and municipal governments, which are financially supported by the Provincial Government, also adopt quality management principles. Alberta's hospitals seem to be well on their way to making this change. With respect to educational establishments, not only should they introduce quality management concepts into the management of their operations, but they should also strengthen course offerings in quality management as well.

The Government must continue and enhance its efforts to encourage Alberta companies to adopt the quality management philosophy. The Department of Economic Development and Trade, as one example, has a major quality management promotional program underway, and plays a leading role in the management of the Quality Council of Alberta. Where they are not already doing so, other departments and agencies which interface with the private sector, should undertake similar vigorous promotional activities. It would be expected that these recommended campaigns could be implemented without employing additional resources - by reallocation of existing resources. As more Alberta companies adopt quality management principles, Alberta Public Works, Supply and Services could require its suppliers to be quality management oriented, especially in the area of "just-in-time" delivery of supplies, for example.

It is also recommended that some form of prominent awards should be given to companies which are implementing quality management practices. These awards should be given a high profile and could be referred to as "Premier's Awards" or "Lieutenant-Governor's Awards", for example. It would also be desirable to develop other awareness programs to make Albertans generally aware of the benefits of the quality management philosophy.

The net anticipated result of these recommendations when implemented will be to enable Alberta companies to succeed in international markets, thereby increasing the benefits to be derived from the sale of high value added tradeable goods and services. For organizations in Alberta, quality management is expected to reduce overhead costs, improve employee job satisfaction, increase owners' profits, and result in happier customers, patients, users and clients.

CREATING THE KNOWLEDGEABLE CITIZENRY NECESSARY FOR A KNOWLEDGE-BASED FUTURE

RECOMMENDATIONS:

The Premier's Council on Science and Technology recommends that the Toward 2000 process support:

- the redesign and improvement of elementary school science instruction, techniques and in-servicing with a doubling of instructional time for science over the next three years.

- the inclusion within the requirements for an Alberta Professional Teaching Certificate at the elementary level, the successful completion of a laboratory oriented, multidisciplinary general science course at the university level.

- the inclusion within the requirements for an Alberta Professional Teaching Certificate enabling science instruction at the secondary level, the successful completion of a B.Sc. in one of the natural science disciplines recognized by an Alberta university.

- the implementation of policies, programs, and practices that (a) facilitate professional growth and development (continuing or recurrent education); (b) cushion the impact of swings in the labour market (alternatives to layoffs); and (c) promote a positive image of those who work with their hands (pride in workmanship). Such policies and programs will make careers in trades and technology increasingly attractive to young people and will contribute to higher retention of employees in these occupational fields and to greater loyalty of employees to their employers.

- the development of information programs that ensure that Albertans are well informed on short- and long-term career prospects in various fields.

- the implementation of policies that ensure Albertans have access to a full range of educational opportunities at post secondary levels in science and technology.

- A culture in which there are no barriers or obstacles restricting women's educational and career choices in science and technology and where women are encouraged to participate in science and technology activities.

- the implementation of a broadly based, long-term, government-wide public understanding program for science and technology.

- encouraging universities to ensure that university graduates, regardless of discipline, have a basic knowledge of natural science sufficient to permit them to understand and discuss scientific issues, in both biological and physical sciences, relevant to their roles as citizens, and potential business or community leaders.

- the increase in the role and representation of business and professional associations on science and technology related curriculum committees at all levels of the education system.

- the active support of science and technology oriented business and professional association partnerships with educational institutions by:
  - the encouragement of their formation and effective execution
  - the establishment of standards and evaluation criteria

INTRODUCTION

The competitive job requirements of the future and the challenging public policy decisions facing all citizens require that Albertans are well educated in science and technology. With this basic knowledge and with ongoing on-the-job training we will have the knowledgeable and productive workforce required to meet the challenges of the next century.

Achievement of this goal will require changes not just by Government but also by individuals and the private sector. Individuals must commit themselves to supporting an increased emphasis on science and technology in our schools and must act on the knowledge that life-long learning is a necessity. The education community must recognize the increasingly important place of science and mathematics education in preparing people for the challenges of the next century. The private sector must participate more actively in business education partnerships and implement on-the-job training programs for staff. Government's role must be to create the appropriate environment in which science and technology related jobs are created and to ensure that the educational infrastructure allows students of all ages to be adequately trained and continually updated for these jobs.

Elementary Science Education

Students learn a tremendous amount at a young age. It is therefore unfortunate when science and math receive little attention in these early years. Science receives less instructional time than any other subject area according to the recommended subject time allocations in the 1990 Alberta Education Program of Studies for Elementary Schools. Japan offers approximately 50% more science instruction at the elementary level. By the end of grade 6, a Japanese student will have had the equivalent of 3 years more science instruction than Alberta students.

The majority of elementary science is taught by teachers who have little or no science background. (The worst case scenario currently possible is the granting of a certificate to teach elementary school with no high school science courses and with only one half course in science methods at the university level.)

In a significant number of Alberta classrooms, the science program consists of integrating science into language arts/social studies work or reading about science from a textbook. This is considered by trained science educators to be marginal science instruction.

All elementary students in Alberta should participate in a relevant, activity-oriented science program emphasizing problem solving and process skill development. This type of program will foster and promote positive attitudes toward science if taught for a minimum of 10-15% of the child's instructional time.

In order to ensure that teachers are adequately trained in science and technology, strategies should be implemented to encourage practising elementary teachers to upgrade their science qualifications. To encourage new teachers and existing teachers to develop a science specialty, appropriate incentives, including salary, should be considered. Another type of incentive to consider might be to require elementary schools to have an appropriately trained science teacher.

To address these issues, the Premier's Council on Science and Technology recommends that the Toward 2000 Together process support:

- **the redesign and improvement of elementary school science instruction, techniques and in-servicing with a doubling of instructional time for science over the next three years.**

- **the inclusion within the requirements for an Alberta Professional Teaching Certificate at the elementary level, the successful completion of a laboratory oriented, multidisciplinary general science course at the university level.**

Secondary Science Education

The junior high science curriculum introduced by Alberta Education in 1989 is perceived to be appropriately designed and well received by junior high teachers. It addresses many of the shortcomings of the previous curriculum. It is being followed by the Science 10-20-30 curriculum that will be introduced by Alberta Education in the fall of 1992. This curriculum addresses many of the concerns with respect to the scientific literacy of the general population. Graduates of this program should contribute positively to the development of a science/ technology culture in Alberta.

Concerns remain however with the specialist science courses. The proposed revisions of the Biology 20-30, Chemistry 20-30 and Physics 20-30 courses reflect minimal changes. Instruction at both junior and senior high level is traditional in approach with decreasing time spent on laboratory work as the grade level increases. Currently less than 10% of high school graduates pursue science related studies at the post secondary level. The lack of creative modification of the discipline based courses at the senior high school level will do little to improve this situation.

Good science education requires both a strong curriculum and well qualified teachers. A significant amount of junior high science is taught by teachers who have an inadequate science background for the Alberta curriculum. Although most of the senior high science teachers have a science background, that background is often dated and not always relevant to the courses being instructed. Very few physics teachers have a physics major; physical education majors are often assigned to teach biology and chemistry.

All secondary students in Alberta should participate in an appropriate, relevant, laboratory based, science program emphasizing problem solving and process skill development. This type of program will foster and promote positive attitudes toward science. It must be taught by a teacher who has science expertise in the area of study, utilizing teaching strategies shown to improve retention as well as understanding.

The Premier's Council on Science and Technology recommends that the Toward 2000 Together process support:

> **the inclusion within the requirements for an Alberta Professional Teaching Certificate enabling science instruction at the secondary level, the successful completion of a B.Sc. in one of the natural science disciplines recognized by an Alberta university.**

As well, strategies should be considered to encourage practising secondary teachers to upgrade their science qualifications. Incentives, including salary, might be offered to secondary physical science teachers. In addition, financial incentives in the form of scholarships and bursaries should be provided to persons wishing to become secondary science teachers.

Technical and On-The-Job Training

Canada cannot depend on traditional off-shore sources of tradespersons, technicians and engineers as it has in the past. Rising standards of living in western Europe during the last two decades have made Canada a less attractive destination for skilled workers. Unless there is a dramatic increase in the number of Canadians aspiring to careers in trades and technologies, the country will experience severe shortages of skilled workers and will lack a key prerequisite for its capability to compete. Unfortunately, a widespread societal bias in Canada views vocational/technical/engineering education or training as unworthy of attention by capable students. To attract people into these areas, the jobs need to be accorded recognition and status commensurate with the important contribution they make to the economy and to the quality of life of Albertans.

The attraction of people into technical careers is merely the first start. Ongoing training is necessary to keep them in these fields. Numerous studies reveal that Canadian business and industry spends less on upgrading and retraining of workers than most industrialized nations of the world. On a per employee basis, Canadian firms spend less than half as much on training as American firms. Analysis points to an absence of a "private sector training culture", which recognizes the importance of employer investment in continuing education support for employees as a vehicle for improving productivity and for building employee loyalty.

There may be some reluctance on the part of employers to train employees and have them take up new positions with other organizations. Human resource management practices in Canada have not been particularly conducive to fostering employee loyalty to employers. Layoffs of workers in trades, technology and the employed professions in times of economic downturn, or due to the costs of implementing new technologies, have communicated eloquently that these are career fields fraught with insecurity. Examples of employers introducing imaginative programs to help employees through difficult economic times are rare in the Canadian context.

Retraining and updating are becoming, and will become, more and more important. These should be built into "the system" and the vision of the future of Alberta.

Policies, programs, and practices should be in place that (a) facilitate professional growth and development (continuing or recurrent education); (b) cushion the impact of swings in the labour market (alternatives to layoffs); and (c) promote a positive image of those who work with their hands (pride in workmanship). Such policies and programs will make careers in trades and technology increasingly attractive to young people and will contribute to higher retention of employees in these occupational fields and to greater loyalty of employees to their employers.

Career Information

In a rapidly changing, competitive world it is essential for career counsellors, educational planners, those involved in mid-career retraining programs, etc., to have as much information as possible on future demand for qualified workers. The need to provide career satisfaction for citizens and to achieve reasonable efficiency in the allocation of scarce educational resources dictates that reliable methods to predict needs for particular knowledge and skills must be developed and used.

Many studies suggest that more skilled labour is required for Canada's future S&T competitiveness, and women are expected to make up the bulk of new entrants to the workforce. Based on this assumption a clear need exists for changes to attract and retain more women in all the scientific and technological fields.

It is critical that Albertans are well informed on short- and long-term career prospects in various fields and, have access to a full range of educational opportunities at post secondary levels in science and technology.

There needs to be a culture that encourages women to participate in science and technology activities: a culture in which there are no barriers or obstacles restricting women's educational and career choices in science and technology.

Broadening General Understanding of S&T

To fully utilize, within a society, all of the advances made possible by science and technology, there must exist a grassroots respect and appreciation for science. All Albertans need to develop a "life experience" understanding of science and technology in order to perceive science and technology as an integral part of our culture. This will mean that all of the many stakeholders involved in "selling" science as a positive force are effectively coordinating their activities.

The opportunity that presents itself is to demonstrate credibly to the public the real and positive role that science plays in every part of society. Credibility requires a recognition that science and technology are tools that can be used for the benefit of society or they are tools that may be used negatively. People have the responsibility to be sufficiently informed so that these choices are made knowledgeably.

Our post-secondary education system can also make an important contribution to the general understanding of science. The need for a broad scientific education holds for both those who are planning to specialize in science and engineering and those who are not.

It is important, in the view of the Council that a broadly based, long-term, government-wide public understanding program for science and technology, be implemented.

Universities need to ensure that university graduates, regardless of discipline, have a basic knowledge of natural science sufficient to permit them to understand and discuss scientific issues, in both biological and physical sciences, relevant to their roles as citizens, and potential business or community leaders.

Business and Education

It is important to have business and education work collaboratively to enhance the quality of the education system and its impact on Canada's future competitiveness and prepare its youth for tomorrow's world.

Greater involvement by business is driven by the increasing need to develop an effective long-term human resource strategy. Business has much to contribute, including a world of work perspective, input to curriculum development and skill enhancement programs, and extensive experience in how to respond to change.

The business world is going through turbulent times. A rapidly changing and increasingly sophisticated economy, technological change, the information revolution, stronger international competition, volatile market conditions and changing employee expectations are just some of the pressures on today's company executives. Yesterday's concepts and practices are being rigorously challenged. The stakes are high.

Tomorrow's strategies for business success will depend largely on effective human resources. More and more, business leaders recognize that improving education at all levels and for all ages, in Canada is crucial in order to ensure an adequate supply of well educated and skilled employees for the future. This stems from a clear recognition that human beings are the most valuable assets of any firm. They produce the goods and services, and they mean the difference between success and failure. Consequently, corporate involvement in education is fundamental to business success.

To compete effectively, Canadian business will require well educated, highly skilled and effectively trained people. In North America, however, demographics suggest there will be intense competition for an increasingly limited supply of human resources. Labour markets will be much tighter in the future than in the past, particularly for highly trained young people. The prospects are for much more intense competition among recruiters on university and college campuses and, increasingly, at secondary schools.

Of particular importance to business is an increased enrollment of students and increased competence in mathematics, science and engineering. More graduates with science and technology expertise are needed to enable Canada to successfully meet global competition. The achievement of this goal will require an improved science and technology culture and education. Business can contribute much to this end. Furthermore, it has demonstrated its willingness to contribute, e.g., partnerships and cooperative programs.

To address these issues the Premier's Council on Science and Technology recommends that the Toward 2000 process support:

- **the increase in the role and representation of business and professional associations on science and technology related curriculum committees at all levels of the education system.**

- **the active support of science and technology oriented business and professional association partnerships with educational institutions by:**
  - **the encouragement of their formation and effective execution**
  - **the establishment of standards and evaluation criteria**

- The Premier's Council recommends that the role and representation of business and professional associations on science and technology related curriculum committees at all levels of the education system be continued and expanded.

- It is also important that science and technology oriented, business and professional association partnerships with educational institutions be actively supported. In this regard the Premier's Council suggests that Government work with business to establish standards and evaluation criteria for S&T related business education partnerships.